Unitywater

Serving you today, **investing in tomorrow.**

Pr9788 - Specification for Horizontal Directional Drilling

Pr9788 - Specification for Horizontal Directional Drilling

Documents Details

This document is only valid on the day it was printed.

Document Sponsor	Infrastructure Standards and Product Approval Committee
Document Owner	Head of Asset Management
Document Contact	Infrastructure Standards and Assurance Team
References	Refer to Appendix B

Version Review

Revision	Reviewed by	Approved by	Date approved	Change	Reason for Change
2.0	B. Maule	A. Schoenmaker	30/11/2016	Correct references to other UW technical standards	Consistency
3.0	G. Burnett	G. Burnett	02/10/2018	Periodic review	N/A
4.0	B. Maule	A. Creevey	23/10/2018	General refinement of specification as a result of lessons learned	Lessons learned from previous project
5.0	L. Bryson	N/A	N/A	Reflect current WSAA reference	Minor admin amendment. No change to review dates.
6.0	B. Maule	G. Burnett	10/10/2019	Section 7.6.14 Tracer Wire	Clarification of requirement
7.0	L. Bryson	N/A	N/A	Update template and fix sub numbering errors	Minor admin amendment 24/04/2021
8.0	B. Maule S. Byrne	Y.Skinner	30/07/2021	Update definition of Principal & change Document Owner.	Clarification for projects delivered by Developers
9.0	L. Bryson Y. Skinner	N/A	N/A	To update legislation title *Queensland Building Services Authority Act 1991* to *Queensland Building and Construction Commission Act 1991* (Qld)	02/06/2022 Minor admin amendment. No change to review dates.
10.0	L. Bryson	N/A	N/A	To replace DBYD references with Before You Dig Australia as per new service branding.	05/09/2022 Minor admin amendment. No change to review dates.
11.0	Y Skinner	K Goraya	14/12/2023	Reformat & renumber to new technical specification template. Note that timeframes for submission of documents may be varied. Minor spelling errors	Periodic review
12.0	L. Bryson	N/A	N/A	Replace Workplace Health & Safety Legislation with Work Health & Safety as correct reference	13/03/2025 Minor admin amend. No change to review dates.
13.0	L. Bryson	N/A	N/A	Update position / Branch titles as per current SIS org structure	06/08/2025 Minor admin amend. No change to review dates.
14.0	L. Bryson	N/A	N/A	Update next review date	23/09/2025 Minor amend to update next review date to align with review action plan (to review with other Trenchless suite of Specs)

Unitywater
Serving you today, investing in tomorrow.

Pr9788 - Specification for Horizontal Directional Drilling

Contents

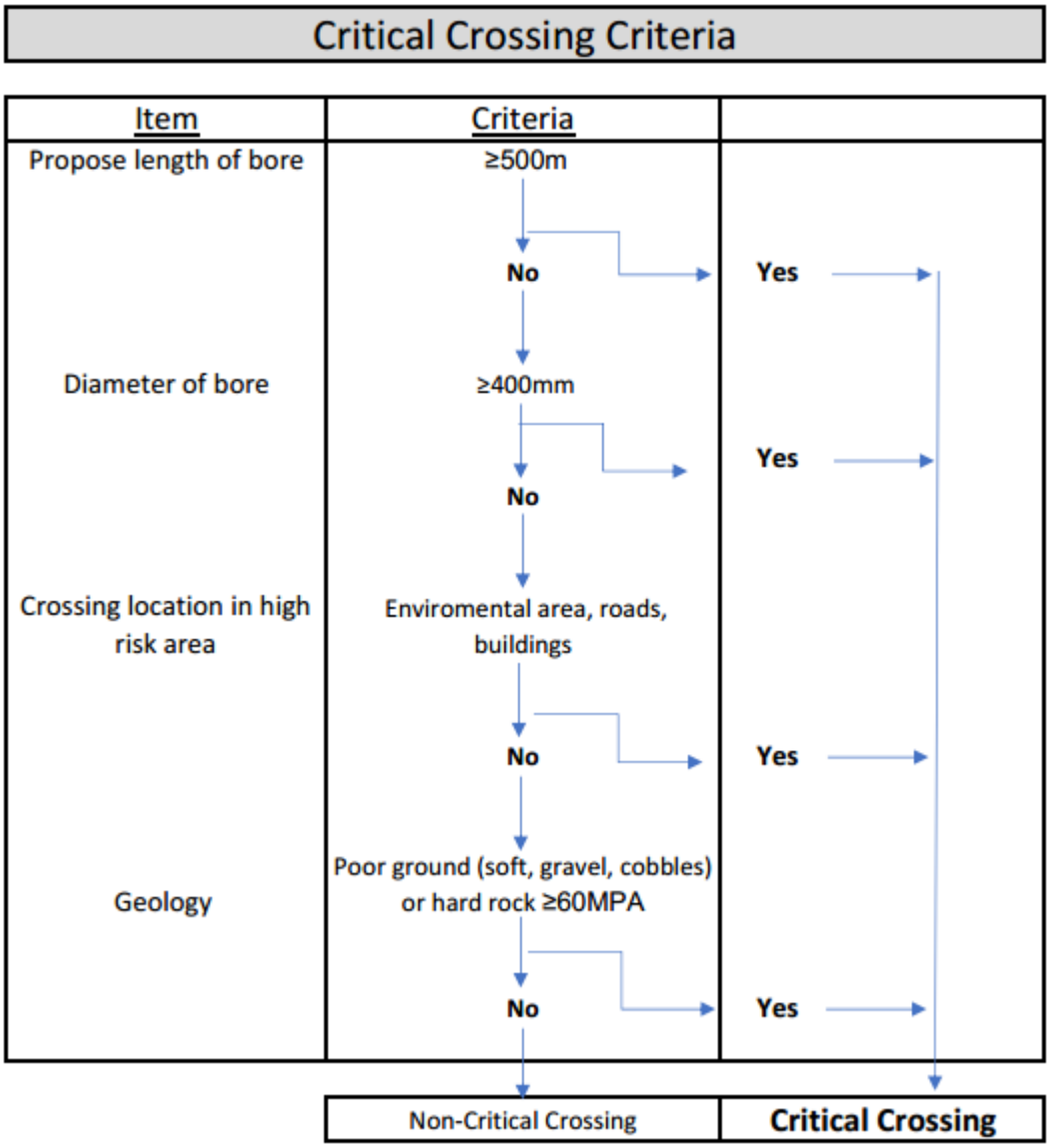
List of Tables

1. Purpose

The intent of this Document is to outline the minimum deliverables and standards that the contractor needs to comply with when performing Horizontal Directional Drilling (HDD) works on Unitywater projects.

Its purpose is to ensure consistency across all projects delivered by Unitywater and that the safety, quality, environmental and design objectives required by Unitywater are achieved.

In addition to the requirements in this document, a particular drilling crossing may be assessed as "Critical". In this instant the additional requirements in Appendix C – Additional Requirements for Critical Creek Crossings also need to be adhered to. As a minimum, the Critical Crossing Criteria table below shall be used in this assessment.



2. Scope

This Specification defines the minimum technical requirements for Horizontal Directional Drilling construction works undertaken on Unitywater projects.

2.1 Definition

Horizontal directional drilling (HDD) shall be defined as a trenchless construction method for installing pipelines which incorporates the following features:

- pilot hole is drilled along the design alignments using a steerable and trackable drill
- the hole is reamed to the required diameter in one or more passes
- the carrier pipeline is pulled through the enlarged borehole
- the drilled hole is continuously stabilised by use of a bentonite or polymer drilling fluid.

2.2 Order of Precedence

Where a discrepancy exists between the Drawings, this Specification and the other Unitywater specifications the Contractor shall seek clarification from the Superintendent's Representative.

This Specification shall take precedence over any other standard, code or guideline, but cannot diminish any requirement of a standard, code or guideline to which compliance is required by law within the jurisdiction of the work being performed.

All other applicable standards, codes and specifications referred to by documents that form part of this Specification shall also be followed.

2.3 Principal/Standard Drawings

Where the form of Contract is "Design and Construct", the Principal Drawings are a high-level concept design of the Principal's project requirements. The Contractor is to use these drawings as a guide to base the preliminary and final design upon. The Principal Drawings will typically illustrate the following elements:

- site constraints
- an indicative trenchless alignment according to best practice
- pits, shaft or tie in locations
- approximate drive lengths
- jacking/enveloper/casing pipe and carrier pipe details.

Alternatively, where the form of Contract is "Construct Only", the Principal Drawings are a prescriptive representation of exactly what is to be constructed under the Contract. These drawings will include the minimum information that the Contractor will require to build the works. The contractor shall be responsible to identify any changes required, or ambiguities found, in the Principal Drawings which must be discussed and resolved with the Principal immediately.

3. Project Preliminaries

3.1 Approvals

For a Design and Construct contract, third party approvals are to be obtained by the Contractor. For a "Construct Only" contract third party approvals usually obtained by Unitywater, however, in some instances approvals may be the responsibility of the Contractor. The Contractor is to refer to the Project Specific Specification for required approvals.

No work is to begin on site preparation or HDD activities until all relevant permits and approvals have been gained and signed off by the relevant authority. The following authorities may be required to authorise the works:

- Queensland Government Department of Transport and Main Roads
- Queensland Rail and/or other rail infrastructure owners
- Local Government
- Other Service Providers
- Private land owners.

The Contractor shall be required to adhere to any approval conditions that the Principal or asset owner specifies.

3.2 Design

The Contractor shall be responsible for the design and construction of all aspects of the HDD works including any temporary works and temporary supporting structures. All design assumptions regarding subsurface conditions, equipment requirements, groundwater and other factors are the responsibility of the Contractor and shall be fully documented.

Based on the alignment shown in the Principal Drawings, the Contractor shall design and size the excavated profile to accommodate all temporary and permanent works.

A design vertical and horizontal profile shall be submitted to the Superintendent's Representative for review prior to commencement of work.

The Contractor shall not proceed with any work until the Contractor's RPEQ certified design has been accepted by the Superintendent's Representative. Acceptance of the Contractor's design by the Superintendent's Representative in no way diminishes the responsibility of the Contractor for the design.

The HDD crossing shall be designed in accordance with this Specification and the referenced documents by a person suitably qualified and having experience with the design considerations required for this type of work. The profile design shall take into account the following:

- temporary works associated with the HDD construction
- pipe/drill rod bending radii
- steering capability of the proposed method/equipment
- drilling fluid performance
- tensile loads (expected and maximum allowable)
- potential for hydrofracture
- pipeline materials properties (typically Steel, HDPE or PVC) & operations requirements (lifespan and loads)
- location of existing services.

The Contractor shall be responsible for submitting a design document package for review and approval. The document package shall form part of the Contractors ITP as a hold point. The document package shall include but not limited to:

- detailed profile design drawings
- temporary works design – Drill rig thrust restraints, shoring systems, pits etc.
- drilling Fluid Design and Management Program
- settlement.

The Principal Drawings shall be used as a guide to confirm that the crossing is possible to be delivered via HDD methods. The Contractor is not to rely on the Principal Drawings as being the built solution as it is the Contractor's responsibility for the final alignment and design, and any temporary works design required.

The Principal will be responsible for the operational design of the permanent pipeline, however the Contractor is required to confirm the suitability of this pipe for installation via HDD methods.

All temporary works are to be designed by an RPEQ engineer taking into account the ground conditions. Any modifications to temporary works are to be approved by the RPEQ engineer prior to works being carried out.

Under the design requirements of this Specification the Contractor is to produce the Drawings outlined in **Table 1** below.

Table 1 – Design Drawing Requirements

Drawing Details	Plan / Elevation
Site Layouts (incl. Laydown, Storage areas, Entry and Exits)	Plan
HDD Alignment	Plan + Elevation
Borehole details	Elevation
HDD Pipe Stringing Layout	Plan

3.3 Governing Documentation

As a minimum and in addition to the documentation required in the Contractor Management Plan Requirements, the Contractor must submit for approval the following governing documentation as outlined in the tables below:

Table 2 – Work Plans

Procedure	Submission
Major Lift Plan(s)	4 weeks before work
Plant Suitability and Maintenance Plan	4 weeks before work
Risk and Contingency Management Plan	4 weeks before work
Inspection Test Plan(s)	4 weeks before work

Table 3 – Document Package

Design Documentation Submittals	Submission
Detailed Profile Design Drawings	4 weeks before work
Temporary Works Design – Drill Rig Thrust restraint, shoring systems, pits etc.	4 weeks before work
Drill Fluid Design and Management Programme	4 weeks before work

Table 4 – Work Procedures

Procedure	Submission
Site establishment	4 weeks before work
Horizontal Directional Drilling	4 weeks before work
Fluid Design and Management	4 weeks before work
Conductor Casing Installation (If required)	4 weeks before work
Horizontal Directional Drilling Surveying	4 weeks before work
Casing pipe welding (or jointing) (If required)	4 weeks before work
Carrier pipe welding (or jointing)	4 weeks before work
Pipe pull back (including overbend details)	4 weeks before work
Annulus grouting (if required)	4 weeks before work
Hydrostatic testing and Chlorination (If required)	4 weeks before work
Demobilisation of equipment and site	4 weeks before work

Table 5 – Safe Work Method Statements

Safety Work Method Statements	Submission
Operation of a crane	4 weeks prior to works
Operation of the HDD Rig	4 weeks prior to works
Operation of the slurry system	4 weeks prior to works
Operation of the water treatment plant	4 weeks prior to works
Work at heights	4 weeks prior to works
Work in a confined space	4 weeks prior to works
Hot works	4 weeks prior to works
Work at night under artificial light	4 weeks prior to works
Lifting	4 weeks prior to works

NOTE: These time frames may be varied either by written agreement or nominated in the Project Scope of Works.

3.4 Risk Assessment and Control

The Contractor is to prepare and implement an approved contingency plan dealing with the key HDD risks identified in the risk register. As a minimum the Contractor is to have defined plans complete with equipment and materials on standby to mitigate against the following HDD risks:

- Fluid loss.
- A hydrofracture event.
- Hydro-lock (loss of fluid circulation).
- Hole collapse.
- Fluid pit overflow.
- Hydrocarbon spill.
- Drill pipe or Bottom Hole Assembly failure.
- Serious workplace safety incidents in remote areas.

Contractor shall provide a detail procedure for fluid management to be followed and timely notification given to Unitywater.

Risk assessment for project and controls shall be assessed per every drill program while ensuring that risks are effectively communicated to personnel performing the works.

3.5 Geotechnical Information and Risk

A Geotechnical Investigation will be carried out by the Principal for the project and the resulting information is to be provided to the Contractor in the form of a factual report (Geotechnical Data Report), or complete Geotechnical Baseline Report (GBR). The Report will cover a minimum set of requirements/criteria to aid and guide the Contractor to assess the project and specifically make informed decisions with regards to:

- rig selection
- tooling and drill pipe selection
- penetration rates
- conductor casing
- casing pipe
- hydrofracture risk
- drilling fluid program
- time and cost
- potential pullback loads
- carrier pipe selection
- temporary works design.

The level of geotechnical investigation shall be determined by, but not limited to the following inputs:

- proposed methodology
- local site geology
- local site hydrogeology
- project capital value.

The Contractor shall inform itself thoroughly and make its own deductions and conclusions as to the difficulty of maintaining required excavations and of doing other work affected by the geology and hydrogeology of the site. The Contractor shall supply a drilling fluids program relevant to the geotechnical information and associated risks relevant to the site conditions.

The Contractor shall include all relevant matters of geotechnical information in the relevant ITP for works included.

Where the Contractor considers it necessary that additional site or subsurface investigations/reports are required, the Contractor shall bring this to the attention of the Superintendent's Representative in a timely manner.

No warranty is expressed or implied that any information, opinions or conclusions, given in any factual or interpretive ground investigation report, supplied in good faith by the Principal, will present a complete or accurate picture of the Site.

4. Procurement

4.1 Approved Suppliers

The Contractor is to provide materials which have previously been approved for use as per the SEQ Water Supply and Sewerage Design and Construction Code Accepted Civil Products and Materials.

If the Contractor proposes to utilise non pre-approved products these are to be submitted to the Superintendent's Representative for consideration.

4.2 Principal Supplied Materials

The Contractor shall document the receipt of any Principal Supplied Materials formally with the Superintendent's Representative. The receipt of materials by the Contractor accepts the suitability of these products for inclusion in the Works.

All Principal Supplied materials shall be handled strictly in accordance with the manufacturer's written instructions at all times.

4.3 Delivery, Storage and Security of Materials

The Contractor shall comply with, National Transport Commissions – Load Restraint Guide 2018, the manufacturer's instructions for delivery, handling and storage of pipes and fittings, and with Specification for Pressure Pipe Construction (Pr9904)

The Contractor is to provide security for the Site and Works including the construction facilities, plant and equipment. Materials shall also be secured by the Contractor to prevent their removal by unauthorised personnel.

All pipes are to be maintained clean and dry (capped, plugged or blank flanged) from manufacturers facilities to final installation.

During construction, when pipes may be located outside the secured area for welding and/or laying purposes, they shall be located in a safe and stable location, secured from movement via wedges and capped to stop any vermin or the public, access internally into the pipes.

4.4 Materials

Permanent materials are to fully comply with this Specification and the documents referenced herein. The Contractor shall prepare and submit Suppliers Certificates for all permanent materials to be included in the works.

The Contractor is to ensure that chemicals and hydrocarbons are used according to Principal's accepted environmental practises complete with control measures to mitigate risk.

The Contractor is to ensure that the drilling fluids and chemicals that have the potential to come into contact with the ground are biodegradable, safe to water bodies and fire resistant.

4.5 Personnel

Appropriately trained and experienced personnel are required for the delivery of the works. **Table 6** below summarises the minimum training and experience required for key personnel. Details of key personal experience shall be provided to the Superintendent's Representative for approval before the works commence.

A HDD supervisor who is thoroughly knowledgeable of the equipment, drilling and HDD procedures is to be present at the job site during the entire installation and be available to address immediate concerns and health and safety issues.

Table 6 – Key HDD Personnel Training and Experience

HDD Role	Training / Qualification	Experience in Role (Years)
Project Manager	Min Higher Education Diploma	5
HDD Supervisor	Rig and fluid training	3
HDD Driller	Rig and fluid training	1
HDD Offsider	Fluid training / Bore Tracking	1

4.6 Plant

All trenchless construction operations shall be performed using specialist equipment.

All plant must be of a good standard and the Superintendent's Representative shall be permitted to visit the premises of the storage, manufacture or refurbishment of proposed specialist plant for the purpose of inspection. The key Principal's equipment assessment / inspection criterion is listed below:

- plant is required to be in good safe working order
- plant is required to have a good service history
- plant is required to be fit for purpose.

The Contractor's management plans must detail a system for daily checking and resolving of issues with the supplied plant and equipment.

As a minimum the HDD Contractor is to supply the following plant:

- HDD drill rig
- drilling fluid pump
- excavator
- fit for purpose lifting machine for drill rod and pipes
- a separation system (If required)
- bentonite mixing plant
- power generator
- hot works plant
- storage tanks.

The HDD Contractor must have the appropriate contingencies in place to address any breakdowns so that the success of the drilling works is not compromised.

The HDD Contractor's management plans must detail a system for daily checking and resolving of issues with the supplied plant and equipment. The Contractor must supply key critical spares to ensure that the HDD drilling equipment achieves a 90% working availability target.

4.7 Drill Rig

The drill rig must be adequately sized (thrust, pullback and torque) to be able to drill a borehole of the appropriate size, in the ground conditions indicated and pull in the product pipe or casing pipe.

The characteristics of the classification for HDD rigs are outlined below in **Table 7**.

Table 7 – HDD Small, Medium and Maxi Rig Classification Characteristics

Attribute	Small Rig	Medium Rig	Maxi Rig
Thrust/Pullback	< 40,000 lbs	40,000-100,000 lbs	>100,000 lbs
Max Torque	< 9,000 ft. lbs	9,000-20,000 ft. lbs	>20,000 ft. lbs
Rotational Speed	> 130 rpm	90-210 rpm	< 210 rpm
Carriage Speed	> 100 ft./min	90-100 ft./min	90 ft./min
Carriage Drive	Chain, Cylinder, or Rack & Pinion	Chain, Cylinder, or Rack & Pinion	Rack & Pinion with or without Cable Assist
Drill Pipe Length	1.5 – 3m	3 – 9.2m	9.2 – 12.2m
Drilling Distance*	< 200m	< 600m	< 2500m
Power Source	< 150hp	150-250 hp	> 250 hp

* Note this is highly dependent on required borehole size and ground conditions.

4.8 Mud Pump

The mud pump must be sized appropriately to adequately cope with the volumes of drilling fluid required and to maintain adequate annular velocity in the borehole in ensure cuttings remain in suspension in the drilling fluid until the fluid exits the borehole.

4.9 Drilling Fluids Mixing and Separation System

To enable continuous drilling and reaming operations an appropriately sized drilling fluids mixing system shall be utilised to handle with the fluid volumes required.

If a separation (recycling) system is to be used it must be adequately sized to handle the through-put of the drilling fluid so continuous drilling and reaming operation can be maintained.

The separation system must be complete with screens and hydro - cyclones to separate the solids from liquid. If required, the Contractor is to provide a centrifuge to further separate the solids from liquids.

4.10 Lifting Plant

Lifting plant is to be appropriately employed by the Contractor. The Contractor is to ensure that experienced personnel with the required certificate of competency operate the lifting equipment at all times. All crane operation is to be in accordance to AS 2550 Cranes, hoists and winches Safe Use.

In the case where the Contractor chooses to use an excavator to lift plant and materials the hydraulic cylinders must be fitted with burst protection valves to the Australian Standard: AS 1418 Cranes, Hoists and Winches.

5. Project Execution

The Contractor shall maintain control of site operations at all times. The Contractor has ultimate responsibility for site safety, the environment, quality workmanship and the satisfactory completion of the work as authorised under the Contract.

5.1 Site Setup

The Contractor is to set the drill entry and exit sites up in accordance with the approved site layout drawings which as a minimum must cover the following key aspects:

- temporary access
- perimeter fencing in the allowed location
- site topsoil stockpile complete with erosion and sediment control
- entry and exit points
- pedestrian walkways and appropriate exclusion zones around cranes or moving plant
- equipment locations and movement zones
- any underground or overhead power lines and the appropriate exclusion zone
- shaft / pit locations
- traffic guidance systems.

The Contractor shall follow the site layout submitted to the Principal. Any changes to site layout are to be documented and approved by the Principal.

5.2 Existing Services

All existing services shall be located prior to works commencing in accordance with the requirements of Unitywater Specification for Civil and Earth Works (Pr9902). Services may require visual confirmation pending proximity to works.

Existing services location and pot holing shall be included and detailed in the relevant ITP with hold points. The contractor shall also produce a procedure for locating existing services.

5.3 Dilapidation Reports

The Contractor is responsible for all pre-construction and post-construction property assessments. These assessments shall be a means of determining whether, and to what extent, damage has resulted from the Contractor's operations during the Works. Any damage identified shall be made good at the Contractor's expense.

As a minimum the dilapidation reports shall capture:

- All work sites and any surrounding area likely to be impacted by the construction activities, including heavy vehicle traffic.
- A minimum distance of 3x the depth of any excavation measured perpendicular to its perimeter.
- Any area within the settlement trough or zone of influence as defined by the Contractors prediction of ground settlement.
- The report must capture the condition of all aspects of the natural and built environment within the nominated areas, including but not limited to inside buildings, public utilities and plant, roadways and landscaping.

The Contractor shall be responsible to identify any critical structures relevant within 10m or less proximity of proposed HDD works. Critical Structures shall represent a hold point in the Contractors relevant ITP. Critical structures shall include but not limited to:

- bridges
- tunnels
- buildings and foundations
- infrastructure assets and associated structures.

5.4 Monitoring and Reporting

A reporting and auditing schedule must be prepared as part of the approvals process prior to commencing the Works.

During the HDD works the Contractor is to provide records as listed in Table 8 below.

Table 8 – Technical HDD Information Records

HDD Record / Report	Included Information	Handover Frequency / Details
Rig Log (Pilot, Reaming and Conditioning)	Rod time. Torque and carriage forces. Geology and fluid comments (returns / losses).	Inspection as and when required during drilling.
Steering Log	Azimuth, length and inclination.	Inspection as and when required during drilling. Submission at end of the pilot hole phase.
Pipe Pull Back Logs (Casing and Carrier)	Rod time. Torque and carriage forces. Fluid comments.	By noon the next day after completion of pull back operation.
Filling and Pre-Hydro Test Logs	Water quantity, times and pressure.	By noon the next day.
Filling and Post-Hydro Test Logs	Water quantity, times and pressure.	By noon the next day.
Grouting Logs (If required)	Grout quantity, times and pressure.	By noon the next day.
Plotted Pilot Hole As-built	Plotted as-built bore path relative to the designed and planned bore path.	Completion of pilot hole.
Welding Logs	Welder, weld type, number, date, if tested and rods used.	By noon the next day.
Resources	Details of plant materials and labour	By noon the next day.

5.5 General Earthworks

General earthworks requirements shall conform to the requirements of the Unitywater Specification for Civil and Earth Works (Pr9902).

As a minimum all excavations will be backfilled and compacted to 95% Standard Compaction (AS1289.5). Landscaping will be restored to its original condition. At the end of the works, temporary shaft(s), pit(s) and all other temporary structures are to be removed to a level of 1.5m below finished site surface level. All HDD spoil, slurry and drilling fluids shall be disposed of by the Contractor to approved sites.

5.6 Drilling and Pipe Installation

5.6.1 Drilling Water

Unless otherwise noted in the Project Specific Specification the contractor shall be responsible for the supply, transport and storing of water required for drilling and hydrostatic testing.

5.6.2 Pipe Welding and Jointing - General

Butt welds are to be used for all pipe joints of all pipe materials that are pulled through the HDD alignment. Other methods of jointing including electrofusion, clamped or proprietary bell/spigot type joints are not permitted without written approval from the Superintendent's Representative.

Pipe specifications, weld procedures and welder qualifications are to be provided to the Superintendent's Representative for approval prior to procurement of any materials or commencement of the works.

Pipe handling shall be only carried out by certified lifting plant and equipment. Care shall be taken with pipe rollers ensuring that they are fit for purpose, in good working order and positioned correctly for the intended task.

5.6.3 Pipe Welding and Jointing – HDPE Pipe

Jointing of HDPE pipes is to be conducted in accordance with Specification for Pressure Pipe Construction (Pr9904).

HDPE welding is to be conducted only by pre-qualified welders. HDPE butt welding quality checks are to be completed in accordance with Specification for Pressure Pipe Construction (Pr9904) Quality Assurance systems and AS 2033 Installation of Polyethylene Pipelines.

5.6.4 Pipe Welding and Jointing – PVC Pipe

PVC pipe is to meet the material specifications required by the referenced standards and be of the fusible type, supplied with a manufacturer's recommendation for butt fusion welding.

5.6.5 Pipe Welding and Jointing – Steel Casing

To provide extra stability to the borehole, or as a requirement of a third party, steel casing may be used.

The steel pipe is to be welded by certified welders pre-qualified to undertake the weld procedure for structural welds.

The yield strength and wall thickness of steel casing is to be chosen by the Contractor to take into account the buckling, bending and tensile forces that it will be subjected to during installation.

The Contractor is to verify that there is no weld slag left internally at the joints that will damage the carrier pipes during installation.

5.6.6 Pipe Welding and Jointing – Pipe Stringing

The carrier and / or casing pipes, if possible, shall be strung out and welded in one (1) long string at a location to facilitate ease of insertion into the borehole. All precautions shall be taken to ensure the pipe string is protected from damage.

If multiple strings are required, based on constraints of the site, a golden weld procedure shall be submitted and heightened criteria applied to ensure minimisation of potential risks.

Pipe rollers if utilised shall be positioned correctly to ensure pipe is not damaged and fit for purpose.

5.6.7 Drilling Fluid Management

The Contractor is to use drilling fluid to efficiently support the borehole and carry the cuttings away in solution to the surface. The drilling fluid is to be water-based bentonite or polymer that is environmentally safe and conforms to the relevant legislation.

All chemical fluid additives are to be inert to the environment and the Contractor is to maintain an up to date chemical register and have SDS documents available onsite.

The Contractor is to provide a Fluid Management procedure which shall include but not limited to:

a. Drilling Fluid program.

b. Management of cuttings including volume on site, specialised site storage.

c. Management of drilling fluid displacement during pullback (expected volumes per time, proposed storage).

d. Safety Data Sheet(s).

If the Contractor proposes to use a separation system, it must be adequately sized to handle the through put of the drilling fluid. The separation system must be complete with screens and hydro cyclones to separate the solids from liquid. If required, the Contractor is to provide a centrifuge to further separate the solids from liquids.

In the event that a drilling fluid hydro fracture occurs, the Contractor shall cease drilling and notify the Superintendent's Representative.

The contractor shall have a contingency plan in place in the advent that a hydro fracture of drilling fluid occurs. The contingency plan shall address the following:

- responsibilities
- monitoring
- emergency response procedures
- equipment available for containment control and clean up
- proposed methods for clean-up
- procedure for continuation of drilling.

Drilling fluids and drill spoils shall be disposed off-site to an approved location. Details of the nominated disposal site are to the submitted to the superintendent for approval.

All relevant legislation shall be adhered to.

5.6.8 Drilling, Reaming, Conditioning

The Contractor will incrementally perform drilling tasks to prepare the bore hole for the pipe pull. The process should follow the following stages:

- Drill and steer the pilot hole along the approved alignment.
- Ream the pilot hole out to the specified diameter per the Contractor's design and guide shown in Table 9.
- Condition and clean the borehole until the Contractor and the Superintendent's Representative is satisfied that the hole is clean and ready for the casing pipe pull.

5.6.9 Pilot Hole

In the event that the pilot does deviate from the bore path by more than the requirements of Table 10. The Contractor shall notify the Superintendent's Representative and the Superintendent's Representative may require the Contractor to pull-back and re-drill from the location along the bore path prior to the deviation.

Drill bits are to be in good working order and appropriate to the ground conditions indicated.

The Contractor shall provide details on:

- Tooling selection and justification including layout configuration sketch
- Auxiliary equipment and support

5.6.10 Reaming

Upon successful completion of pilot hole and acceptance by the superintendent, the Contractor (if required) shall ream the bore hole, using the appropriate HDD tooling, to a size recommended by **Table 9** below.

Reaming tools are to be in good working order and appropriate to the ground conditions indicated.

The Contractor shall provide details on proposed tool selection and previous operating history if applicable.

Table 9 – Product Diameter and Reamed Diameter Recommended Relationship (NASTT 2008)

Product Diameter	Reamed Diameter
< 8" (< 200mm)	Diameter of product + 4" (100mm)
8" – 24" (200 – 600mm)	Diameter of product x 1.5
> 24" (> 600mm)	Diameter of product + 12" (300mm)

5.6.11 Hole Conditioning

Conditioning of the borehole will be conducted when the reaming has been completed. This operation is to remove any excess cuttings still left within the hole and to improve the condition and stability of the borehole and the borehole walls.

Conditioning reaming tools are to be in good working order and appropriate to the ground conditions indicated.

5.6.12 Pipe Pullback

At the completion of the hole opening and the hole conditioning, the Contractor will commence the casing/carrier pipe pullback. The pipe pullback is a critical operation, and the following must be controlled by the Contractor:

- If the Contractor's design requires the casing pipe to be filled for a preferred buoyant reaction, then the Contractor is to plan and execute this process seamlessly.
- If the Contractor needs to work continuously during this operation, the Contractor is to seek extended working hours from the Superintendent's Representative 6 weeks in advance of commencing the operation. Appropriate lighting will need to be provided.
- Measures need to be taken to ensure that the pipe is not damaged during pullback such as the use of pipe rollers / sandbags if required.
- The Contractor is to plan for the handling, storage and disposal of the displaced drilling fluid during pipe pullback.

The Contractor is required to supply a Pullback plan to include by not limited to:

- proposed start and finish times
- ballast pipe install methodology (if applicable)
- ballast water volume calculations and supply rate (if applicable)
- ballast water storage (if applicable)
- displacement of drill fluid calculations
- truck movements
- approved dumping locations
- resources required
- pullback restraint design to have RPEQ Certification.

In the event that pipe becomes stuck, the Contractor will cease pulling operations to allow any potential hydro-lock to subside and will then recommence pulling operations. If the pipe remains stuck, the Contractor will notify the Superintendent's Representative.

5.6.13 Pipe Damage

Inspection of the pipe exterior "scored" condition shall be undertaken prior to pullback operations taking place and on completion of the pullback operation.

The pipe shall be pulled at least 3m clear of the entry pit location so that the condition of the pipe can be visually inspected.

When there is any indication that the installed pipe has sustained damage, the Contractor shall stop all work, notify the Superintendent's Representative and investigate the damage. The Superintendent's Representative is allowed up to 72 hours to approve or determine if the pipe installation is not in compliance with the specifications.

Product pipe damage greater than 10% wall thickness shall be replaced as per PIPA POP-005 and AS 2666.2. Replaced sections shall be subject to pressure testing requirements and actions taken to resolve occurrence from repeating.

5.6.14 Tracer Wire

For any installations involving HDPE or fusible PVC pipe, a continuous tracer wire is to be installed with the pipe when it is inserted into the borehole. The tracer wire shall be in accordance with the SEQ WS&SD&C Code Accepted Civil Products and Materials List.

5.6.15 Drill Pipe

The Contractor is to supply drill pipe that is in good condition. The drill pipe is to be operated according to the manufacturer's guidelines. The Contractor is to ensure that the drill pipe conforms to its allowable bending radius at all times.

5.6.16 Bottom Hole Assembly (BHA)

The Contractor must use fit for purpose downhole equipment. The equipment must be supported by the manufacturers or local agents. All downhole equipment must be accompanied with service records/reports and proofs that it is in good working order and any threaded joints are torqued to the appropriate makeup torque.

Pulling heads and swivels should be designed to a maximum operating tensile load with an appropriate factor of safety. These limitations are to be provided to the Superintendent's Representative via a manufacturers or approved agent's report.

The Contractor shall supply details on the down hole tooling assembly per profile (pilot, reaming, cleaning, and conditioning) with relevant tooling capacity and operating hours.

The Contractor shall include a hold point in the relevant ITP for document submission of the proposed tooling and BHA's.

5.6.17 Grouting

Unless nominated in the design, annulus grouting is required. The following elements of the grouting procedure must be assessed:

- surface settlement
- grouting pressure shall not exceed P_{max} and any pressure limitation on the carrier pipe
- pipe buckling from ground and hydrostatic loads
- drill path erosion and drainage
- resistivity
- heat transfer
- floatation
- permanent operation.

The Contractor is to provide a grouting procedure of the annulus between the casing pipe and the carrier pipe for approval. A cementitious material should be used.

Grouting of the annulus, management of floatation and thermal reversion, shall be in accordance with the SEQ WS&S D&C Code. Grouting mix design shall be appropriate for the specific pipe materials and site conditions and shall be approved by the superintendent.

The Contractor shall consider a specialist grouting contractor prior to works or justify that personnel on site have the relevant experience and knowledge to perform the grouting.

5.6.18 Pipe Cleaning and Gauging

Pigging and gauging activities shall be submitted as part the Contractors pressure testing procedure.

At the completion of the carrier pipe pull, the carrier pipes are to be pigged and flushed clean. A number of cleaning passes may be required until clean water remains in the carrier pipes. Pig selection shall be relevant to the pipeline material and confirmed with a pig supplier and/or manufacturer. Cleaning acceptance criteria shall be ≤10mm dust penetration with a low density foam pig for a maximum length of 2km. For sections exceeding 2km an agreed value between Unitywater and the Contractor is to be established.

Cleaning pigs shall be numbered, logged, condition noted, and comments surrounding debris removed. Any pigging near residents or the general public shall be controlled to ensure material exiting the pipeline is controlled and does not impact the surrounding area. Silencers shall be used when appropriate.

When pigging with compressed air, gauges shall be used at both ends with constant communication between launching and receiving ends. No tools shall be used on the pipeline until both ends of the pipeline have confirmed the gauges read 0kPa.

The gauging pig is to be sized to the internal diameter of each carrier pipe according to the project specific specification. The Contractor is to complete this work and use a fit for purpose cleaning pig and gauging pig. The gauge plate shall be a minimum 3mm thick, 95% of the internal diameter, segmented and shall be free of defects once received. Location of the gauge plate on the gauging pig is to be at the Contractors discretion. Gauge plate material shall not be able to damage the parent material of the pipeline.

5.6.19 Alignment Tolerances

The HDD bore path must follow the approved designed alignment and conform to the allowable tolerances depicted in Table 10 below unless otherwise detailed in the Project Specific Specification.

The alignment shall be constructed on the project specific centre lines and agreed to by the Superintendent's Representative and Principal.

Table 10 – Horizontal Directional Drilling Tolerances

Horizontal Directional Drilling Alignment Tolerance	Allowable Deviation
Horizontal from Designed Alignment	± 300mm
Vertical from Designed Alignment	± 300mm
Gradient (including entry angle and exit angle)	± 3%
Horizontal Tolerance from Planned Surface Exit	1m

5.7 Survey

Construction control points shall be established sufficiently far away from the work so as not to be affected by ground movement caused by the construction operations. Such control points shall be checked regularly against permanent benchmarks to ensure the accuracy of the HDD construction is not compromised by ground movement.

5.7.1 Borehole Alignment

Depending on the length, depth, topography and characteristics of the proposed crossing/s, the Contractor shall adopt one of either walkover, wireline or gyro HDD survey methodologies to guide the borehole along the designed alignment. The proposed methodology and procedure is to be submitted as per the requirements in **Table 4**.

At least one (1) reading per drill rod is required during the drilling of the pilot hole, registering inclination, heading, length, depth and the orientation of the bent sub. This information shall be recorded on the steering log and be available for inspection of the superintendent as and when required.

The Contractor shall ensure proper calibration of all equipment before commencing directional drilling operation and provide proof of calibration documentation to the Superintendent's Representative

5.7.2 As-Built

As-built drawings of Horizontal Directional Drilling shall be prepared, certified as to their accuracy and submitted by the Contractor to the Superintendent's Representative.

The Contractor shall provide the Superintendent's Representative a complete set of As-Built Plans showing all bores (successful and failed) within 10 calendar days (or at the timeframe nominated within the Project Scope of Works) of completing the work.

The Contractor shall ensure that the plans are dimensionally correct copies of the Contract plans and include roadway plans and profiles, cross-sections, boring locations and subsurface conditions as directed by the Superintendent's Representative. The plans must show appropriate elevations in terms of meters above/below Australian Height Datum (mAHD). As-built plans shall be submitted in CAD (3D DXF/DWG), PDF and hard copy forms.

The Contractor shall include bore notes on each plan stating the final bore path diameter, product diameter, composition of any other materials used to fill the annular void between the bore path and the product, or facility placed out of service. If the product is a casing, the size and type of carrier pipe placed within the casing shall be recorded as part of the work.

As-Constructed details shall comply with the requirements of SEQ WS&S D&C Code – Asset Information Specification.

6. Testing and Commissioning

6.1 Hydrostatic Testing

Hydrostatic testing of the carrier pipe shall be conducted both before and after insertion of the pipe into the borehole.

The Carrier pipe shall be hydrostatically tested as per Unitywater Specification for Pressure Pipeline Construction (Pr9904).

The Contractor is to engage a NATA certified testing authority to conduct the hydrostatic testing. The test must conform to the Unitywater Specification for Pressure Pipeline Construction (Pr9904).

The Contractors Hydrostatic Testing Procedure for the disposal of test water shall be in accordance with Water Services Association of Australia (WSAA) Guideline: Dechlorination of Drinking Water to Discharged Waterways, National Guidance for the Urban Water Industry 2019.

6.2 Leakage Testing

For specific leakage testing requirements refer to the requirements identified in the specific Scope of Works. This may include vacuum testing.

6.3 Disinfection/Chlorination

When disinfection/chlorination testing is required the test and reports are to be prepared by a NATA certified testing authority in accordance with SEQ WS&S D&C Code. All equipment used in the testing process shall be calibrated in accordance with the relevant standards.

The Contractor's Chlorination Testing Procedure for disposal of disinfection water shall be in accordance with Water Services Association of Australia (WSAA) Guideline: Dechlorination of Drinking Water to Discharged Waterways, National Guidance for the Urban Water Industry 2019.

7. Project Completion and Handover

Throughout the construction of the project the Contractor is to complete and submit all records mentioned in the above sections of this document. In addition to these documents the Contractor is to submit the As-Built package in hard copy and electronic format.

The Contractor shall keep records of all trenchless operations, and all such data as directed by the Superintendent's Representative. These records will form part of the As-Built data. All As-Built records are to comply with the requirements of the SEQ WS&S D&C Code – Asset Information Specification.

The Contractor is required to submit As-Built records in CAD format. The Contractor must also submit Red Line Drawings detailing all relevant As-Built records. All submitted records are to be approved by the Superintendent's Representative.

7.1 Documentation Submittals

The Contractor shall liaise closely with the Superintendent's Representative during the documentation of survey work and shall provide the Superintendent's Representative with adequate opportunity to verify any measurement or detail the Contractor considers necessary prior to the commencement of reinstatement operations.

7.2 Post-Construction Dilapidation Report

The Contractor is responsible for all pre-construction and post-construction property assessments. These assessments shall be a means of determining whether and to what extent, damage has resulted from the Contractor's operations during the Works.

8. Principal Representation

The works under the contract will be delivered with a Technical Advisory Inspector on site to ensure the works are executed safely, in an environmentally friendly manner and to an acceptable quality standard.

The availability and need for onsite Principal Representation will be based on the project size, contract value and project risk and will be outlined in the Project Specific Specification.

The Contractor must allow the Superintendent or their Representative access to the drill cab and all drilling records at any time during the project.

9. Typical HDD Inspection and Test Plan (ITP)

The Contractor shall prepare and submit for approval by the Principal at least four (4) weeks (or at the timeframe nominated within the Project Scope of Works) prior to the commencement of microtunnelling works, an Inspection and Test Plan (ITP) for the works in accordance with the requirements of the relevant specifications.

Table 11 below details the typical activities that trigger a visual inspection, witness point verification or hold point release. This list is to be used as a minimum guide for the Contractor to develop their ITP. Items noted with a “C” only need to be addressed for designed critical HDD works.

The Contractor must provide the Principal at least 8hrs notice (or at the timeframe nominated within the Project Scope of Works) of a required visual inspection, witness point verification or hold point release.

Table 11 - HDD Inspection and Test Plan

		Contractor Responsibilities			Principal Responsibilities		
Project Elements	Activity	Visual	Witness	Hold	Visual	Witness	Hold
Project and HDD Documentation	Documents required as per CMPR	☐	☐	☒	☐	☐	☒
	Project Plans	☐	☐	☒	☐	☐	☒
	HDD Procedures	☐	☐	☒	☐	☐	☒
	Safe Work Method Statements	☐	☐	☒	☐	☐	☒
HDD Design	Borehole alignment	☐	☐	☒	☐	☐	☒
	Locate existing services	☐	☐	☒	☐	☐	☒
	Identification of critical structures	☐	☐	☒	☐	☐	☒
	Rig selection and deadman design	☐	☐	☒	☐	☐	☒
	Geology review and discussion	☐	☐	☒	☐	☐	☒
	Fluid design, management and control	☐	☐	☒	☐	☐	☒
	Hydro fracture calculations	☐	☐	☒	☐	☐	☒
	Choice of bottom hole assembly and sizing of bits, reamers and conditioners	☐	☐	☒	☐	☐	☒
	Steering technique	☐	☐	☒	☐	☐	☒
	Casing and casing pipe checks (bending radii, buckling capacity and tensile capacity)	☐	☐	☒	☐	☐	☒
	Pipe pulling load calculations.	☐	☐	☒	☐	☐	☒
	Temporary works design - RPEQ Certification	☐	☐	☒	☐	☐	☒
	Contractor and Principal Design Collaboration 20%	☐	☐	☒	☐	☐	☒
	Contractor and Principal Design Collaboration 60%	☐	☐	☒	☐	☐	☒
HDD Site Setup	HDD site set up	☐	☐	☒	☐	☐	☒
	Proposed tooling and BHA's	☐	☐	☒	☐	☐	☒
	Erosion and sediment controls	☐	☐	☒	☐	☒	☐
	Designated spoil sites	☐	☐	☒	☐	☒	☐
	HDD Pits	☐	☐	☒	☐	☒	☐
	Drilling, excavation, confined space and hot works permits	☐	☐	☒	☐	☒	☐

Unitywater
Serving you today, investing in tomorrow.

Pr9788 - Specification for Horizontal Directional Drilling

		Contractor Responsibilities			Principal Responsibilities		
Project Elements	Activity	Visual	Witness	Hold	Visual	Witness	Hold
Drilling (Pilot, Reaming and Conditioning)	Calibration of survey equipment	☐	☐	☒	☐	☐	☒
	Calibration of rig measuring instruments	☐	☐	☒	☐	☐	☒
	Drill pipe checks conforming to API Drill Pipe Specification	☐	☐	☒	☐	☐	☒
	Drill pipe Makeup torque recommendation	☐	☐	☒	☐	☒	☐
	Swivel certification and report	☐	☐	☒	☐	☒	☐
	Assembly of the bottom hole assembly complete with relevant certificates	☐	☐	☒	☐	☒	☐
	Inspection of rig deadman	☐	☐	☒	☐	☒	☐
	Submission of drilling logs	☐	☐	☒	☐	☒	☐
Pipe Stringing and Casing Welding	Welder prequalification for casing and carrier pipes	☐	☐	☒	☐	☐	☒
	Conforming visual and non-destructive welding tests	☐	☐	☒	☐	☐	☒
	Pipe String visual surface inspection prior to pipe Pull Back	☐	☐	☒	☐	☐	☒
	Verification that there is no weld slag on the inside of the casing pipe that could cause damage during the carrier pipe pull	☐	☐	☒	☐	☐	☒
Pipe Pull Back	Pullback Plan submitted	☐	☐	☒	☐	☐	☒
	Inspection of the over bend plans	☐	☐	☒	☐	☐	☒
	Submission of the pipe pull back logs	☐	☐	☒	☐	☐	☒
Cleaning and Gauging	PIG and water discharge logs documenting volumes, time and pressures	☐	☐	☒	☐	☒	☐
Hydrostatic and Chlorination Testing and Grouting	Hydrostatic and chlorination testing logs and NATA certificate	☐	☐	☒	☐	☐	☒
	Grouting installation records (strength, volume and pressures)	☐	☐	☒	☐	☒	☐
HDD Site Reinstatement, Demobilisation and Completion	Check lists for reinstatement of roads, pits and site	☐	☐	☒	☐	☐	☒
	Obtain substantial completion certificate	☐	☐	☒	☐	☐	☒

Appendices

Refer to following pages.

Appendix A – Definitions, Acronyms Abbreviations

The following definitions, abbreviations and acronyms are used throughout this specification.

Definitions

Table 12 – List of General Definitions

Term	Definition
Act	The QLD *Work Health & Safety Act (2011)* and Regulation (2011).
Annular space	The annular space is the space between the casing pipe and the carrier pipe (if applicable).
Bottom Hole Assembly (BHA)	A component of a drilling rig. It is the front end of the drill string, extending from the bit to the drill pipe. The assembly can consist of drill collars, subs such as stabilizers, reamers, shocks, hole-openers and the bit sub and bit.
Carrier Pipe	The inner pipe forming part of the permanent pipeline, installed within the casing pipe.
Casing Pipe	Pipe installed by horizontal directional drilling to house the carrier pipe. Usually employed where the HDD process will risk damage to the carrier pipe due to the friction or pulling loads.
Critical Crossing	A crossing where the risks associated with the proposed crossing are deemed to be higher and therefore there is a requirement for more detailed analysis during design, RPEQ certification of the design and a heightened level of documentation and record keeping during construction. Additional requirements stated in Appendix “A” also need to be adhered to. A crossing deemed “Critical” will be advised by Unitywater.
Conductor Casing	A large casing usually installed at the entry or exit points of the HDD alignment to provide borehole support in weak or granular geological strata.
Contract	The legally binding agreement between two or more parties for doing or not doing something specified.
Contractor	An organisation that is bound to carry out and complete the works under the Contract.
Contingency Plan	A plan to mitigate the risk of an activity. The plan usually allows for backup procedures, emergency response, and post-disaster recovery.
Debeading	The process of removing the molten bead, either inside or outside the pipe which is formed in the HDPE butt weld jointing process.
Designer	A professional engineer (RPEQ) who is appointed by the Contractor to carry out design and to issue instructions regarding standards, specifications and techniques to be observed in the construction of this project.

Term	Definition
Design Documentation	Drawings, Specifications and other Design Documentation (including design standards, design or durability reports and calculations) in computer readable and written forms prepared by the Designer for the purposes of the Trenchless works under the Contract.
Geotechnical Baseline Report (GBR)	The GBR describes the 'Ground Reference Conditions' at the location (alignment as shown in the GBR) of the proposed alignment. The Baseline Conditions presented in GBR represent what is assumed to be encountered for the purpose of defining "indications of the Contract". The provision of a baseline in the Contract is not a warranty that the baseline conditions will, in fact, be encountered. It is therefore not appropriate for the Principal or Contractor to conclude that baseline statements are warranties.
Ground Loss	Ground loss is defined as the volume of material that has been excavated in excess of the theoretical design volume of excavation.
Hold Point	A mandatory verification point beyond which work cannot proceed without approval of the Principal.
Horizontal Directional Drilling (HDD)	HDD is a trenchless method for installing a product that serves as a conduit for liquids, gasses or as a duct for pipe, cable or wire line products. It is a multi-stage process consisting of site preparation and restoration, equipment setup and drilling a pilot bore along a predetermined path and then pulling the product back through the drilled space. When necessary, enlargement of the pilot bore hole may be necessary to accommodate a product larger than the pilot bore hole size. This process is referred to as back reaming and is done at the same time the product is being pulled back through the pilot bore hole.
Hydro-lock	Is a condition that occurs when the circulation from the bore is lost and the formation is resistant to fracturing or absorption of the drilling fluid, creating a hydraulic cylinder in the ground.
Hydrofracture	Is a condition that occurs when the circulation from the bore is lost and the formation is resistant to fracturing or absorption of the drilling fluid, creating a hydraulic cylinder in the ground.
Makeup torque	The recommended torque forces required to joint each threaded drill pipe connection.
Marsh Funnel	A device for measuring viscosity by observing the time it takes a known volume of liquid to flow from a cone through a short tube.
Operator	Suitably trained or qualified person who operates machinery, an instrument or other equipment.
Permit	A document that controls an activity that is considered high and not able to be commenced without completing important requirements.
Principal	For infrastructure being delivered as Unitywater funded and managed projects, Unitywater. For developer donated infrastructure being delivered under an approval issued by Unitywater Development Services, the Developer's Principal Consulting Engineer (RPEQ, suitably qualified and experienced).
Principal Drawings	Drawings issued to the Contractor forming part of the Contract. These drawings are owned by the Principal and are to be used to guide or govern the work under the contract.

Term	Definition
Project Manager	A person nominated by the Contractor responsible for the construction of the contract.
Red Line Drawings	Approved RPEQ Design drawings marked up as Red-Line, detailing the as-built status data.
Safe Work Method Statement	A document summarising the work required for an activity. This document summarises the hazards and the required measures to control minimise safety risk.
Scope of Work	A document summarising the works to be completed under the Contract.
Separation Plant	An elaborate system of separating excavated material from the transportation fluid. Such a plant would employ shakers, screens, hydro cyclones or centrifuges to achieve this solid / fluid separation.
Specification	This document, that specifies, in a complete, verifiable manner, the requirements, design, behaviour or other characteristics of a system, component, product, result or service and, often, the procedures for determining whether these provisions have been satisfied.
Superintendent	An individual appointed by the Principal to perform two functions: • be the Principal's agent for the works under the Contract • administer the Contract fairly and perform certain certifier requirements.
Superintendent's Representative	A person nominated by the Superintendent, to act on behalf of the Superintendent.
Technical Advisory Inspector	A person nominated by the Superintendent to perform the role of on-site inspector ensuring the trenchless works are being performed in accordance with the approved design and methodology. They shall be adequately experienced in trenchless works and be able to provide technical advice regarding any issue relating to the works.
Trenchless Construction	Installation of new or replacement of underground infrastructure with minimal disruption to surface environment, traffic, business and other activities.
Visual Inspection	The process of looking over a piece of equipment or works using the naked eye. It requires no equipment except the naked eye of a trained inspector.
Witness Point	An identified point in the work process where the Principal may review, witness, inspect method or process of work. The activities however may proceed.

Abbreviations and Acronyms

Table 13 – List of Acronyms

Acronym	Description
ASTT	Australasian Society for Trenchless Technology
AS / NZS	Australian / New Zealand Standard
ASS	Acid Sulphate Soils
AS	Australian Standard
BYDA	Before You Dig Australia https://www.byda.com.au/
CCTV	Closed Circuit Television
GBR	Geotechnical Baseline Report
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene Pipe
ID	Inside Diameter
IFC	Issued for Construction
ISO	International Standards Organisation
ITP	Inspection and Test Plan
NATA	National Association of Testing Authorities
NASTT	North American Society for Trenchless Technology
N/A	Not Applicable
OD	Outside Diameter
PVC	Poly Vinyl Chloride
$P_{average}$	Pressure Average
P_{max}	Maximum Allowable Pressure
P_{min}	Pressure Minimum
QA	Quality Assurance
RPEQ	Registered Professional Engineer Queensland

Appendix B – References

General

Nil.

Applicable Legislation and Regulation

At least the following legislation and related regulation shall apply:

a. *Work Health and Safety Act 2011* (Qld)
b. *Work Health and Safety Regulation 2011* (Qld)
c. *Water Supply (Safety and Reliability) Act 2008* (Qld)
d. *Environmental Protection Act 1994* (Qld)
e. *Queensland Building and Construction Commission Act 1991* (Qld)
f. *Professional Engineers Act 2002* (Qld).

Codes of Practice (ratified by Legislation)

At least the following industry codes of practice apply:

a. *Work Safe Queensland Code of Practice*; Managing noise and preventing hearing loss at work 2021
b. SEQ Water Supply and Sewerage Design and Construction Code (SEQ WS & S D & C Code) including Accepted Infrastructure Products and Materials Lists
c. SEQ WS & S D & C Code Asset Information Specification.

Codes of Practice (not ratified by Legislation)

At least the following industry guidelines shall apply:

a. Australasian Society for Trenchless Technology (ASTT), (2010). *Guidelines for Horizontal Directional Drilling, Pipe Bursting, Microtunnelling and Pipe Jacking*, Rev 1, February 2010

b. North American Society for Trenchless Technology (NASTT), (2008). *Horizontal Directional Drilling Good Practices*, 3rd Edition

c. The Plastics Industry Pipe Association of Australia (PIPA)

d. Water Services Association of Australia (WSAA) Codes

e. Water Services Association of Australia (WSAA) Guideline

- Dechlorination of Drinking Water to Discharged Waterways, National Guidance for the Urban Water Industry 2019.

f. Polyethylene Pipeline Code – WSA 01 – 2004

g. Unitywater Technical Specifications:

- Pr9902 - Specification for Civil and Earth Works
- Pr9903 - Specification for Building and Structural Works
- Pr9875 - Specification for Non-Pressure Pipe Construction
- Pr9904 - Specification for Pressure Pipelines Construction
- Pr9680 - Specification for Electrical Installations at Network Sites
- Pr9693 - Specification for Mechanical Installation
- Pr9825 - Specification for Shafts
- Pr9032 - Procedure for Managing Water Quality during Mains Commissioning
- F10045 - Water Quality Mains Commissioning Form.

Appendix C – Additional Requirements for "Critical" HDD Crossings

As stated in Section 1, in addition to the requirements set out in the document above the following requirements need to be complied with for crossings deemed as "critical".

Item numbering below corresponds to the relevant section in the body of this Specification that is to be replaced for critical HDD projects, or a new section that is to be added.

3. Project Preliminaries

3.2 Design

Additional Sub-Clauses

In addition to Temporary Works the overall design is to be certified by a RPEQ engineer and shall be submitted to the Superintendent's Representative for review prior to commencement of work.

Hydrofracture, Installation load and Pipe integrity calculations shall be carried out and submitted as part of the overall design.

Amendment to Sub-Clauses

In addition to the Design drawing requirements shown in **Table 1** the following is also required.

Table 14 – Design Drawing Requirements

Drawing Details	Plan / Elevation	RPEQ Sign Off
HDD Over Bend Details	Plan + Elevation	☑

3.3 Governing Documentation

Amendment to Sub-Clauses

In addition to the work plan requirements shown in Table 4 the following is also required.

Table 15 – Work Plans

Procedure	Submission
Settlement Monitoring Plan	4 weeks before work

In addition to the documentation requirements shown in **Table 3 – Document Package** the following is also required:

Hydrofracture Analysis	4 weeks before work
Installation Calculations	4 weeks before work
Integrity Calculations	4 weeks before work
Theoretical Settlement	4 weeks before work

4 Procurement

4.5 Personnel

Amendment to Sub-Clause

Alteration to **Table 6 – Key HDD Personnel Training and Experience**.

Table 8 – Alternative Table 8: Key HDD Personnel Training and Experience

HDD Role	Training / Qualification	Experience in Role (Years)
Project Manager	Min Higher Education Diploma	5
HDD Supervisor	Rig and fluid training	5
HDD Driller	Rig and fluid training	3
HDD Engineer	Min Higher Education Diploma	2
HDD Steerer	Survey equipment training	2
HDD Mudman	Fluid training/bore tracking	1

5 Project Execution

z5.4 Monitoring and Reporting

Amendment to Sub-Clause

Alteration to Table 10 of Section 5.4 of this document is outlined in Table 17 below.

Table 16 – Alternative Table 10: Technical HDD Information Records

HDD Record / Report	Included Information	Handover Frequency / Details
Rig Log (Pilot, Reaming and Conditioning)	Rod time, torque and carriage forces. Geology and fluid comments (returns / losses).	By noon the next day.
Steering Log	Azimuth, length and inclination. 3 & 10 joint checks. Position to be referenced to the designed alignment.	By noon the next day.
Rate of Penetration Chart (ROP)	Rod cutting time. Face time. Rig gear / forces. Bit size.	By noon the next day.
Annular Pressure Graph	P_{min}, P_{max} and P_{actual}. Bore profile, ground level.	By noon the next day.
Pipe Pull Back Logs (Casing and Carrier)	Rod time, torque and carriage forces. Fluid comments.	By noon the next day.
Filling and Pre-Hydro Test Logs	Water quantity, times and pressure.	By noon the next day.
Grouting Logs	Grout quantity, times and pressure.	By noon the next day.
Plotted Pilot Hole As-Built (real time)	Plotted as-built bore path relative to the designed and planned bore path.	By noon the next day.
Welding Logs	Welder, weld type, number, date, if tested and rods used.	By noon the next day.
Resources	Details of plant materials and labour	By noon the next day.
Settlement Logs	Details of settlement or heave along the HDD alignment.	Weekly

Alternative Sub-Clause – add at the end of clause 5.4

Surface Settlement

Prior to commencing any construction work within the construction site, condition surveys must be undertaken and recorded in the Settlement Management Plan. Where possible the Contractor is to conduct weekly settlement monitoring along the HDD alignment. These results are to be submitted to the Superintendent's Representative as per **Table 16**.

5.6 Drilling and Pipe Installation

Replace Sub-Clauses 5.6.7 and 5.6.15 with the following

5.6.7 Drilling Fluid Management

The Contractor is to use drilling fluid to efficiently support the borehole and carry the cuttings away in solution to the surface.

Fluid design, performance and monitoring are the responsibility of the Contractor. The Contractor is to submit a Fluid Design and Management Procedure that details the design and required functionality of the fluid. The Fluid Design and Management Procedure needs to be approved by the Superintendent's Representative prior to the commencement of works. The fluid is to be tested a minimum of three times a shift to ensure optimum performance. The Contractor is to record details of all fluid used in the system including quantities of each additive.

The fluid is to optimally perform and is to be tested and verified against the design in the following areas:

- Viscosity
- pH
- Fluid weight
- Gel strength
- Fluid loss
- Water hardness
- Calcium content.

The Contractor is to be in close contact with their fluid supplier's technical department to ensure that optimum performance is established and maintained.

The Contractor is to communicate via the Fluid Design and Management Procedure how the fluid design and management will minimise hydrofracture events, hole collapse and hydro-lock.

All chemical fluid additives are to be inert to the environment and the Contractor is to maintain an up to date chemical register and have SDS documents available onsite.

If the Contractor proposes to use a separation system, it must be adequately sized to handle the through put of the drilling fluid. The separation system must be complete with screens and hydro cyclones to separate the solids from liquid. If required, the Contractor is to provide a centrifuge to further separate the solids from liquids.

In the event that a drilling fluid hydrofracture occurs, the Contractor shall cease drilling and notify the Superintendent's Representative.

The contractor shall have a contingency plan in place in the advent that a hydrofracture of drilling fluid occurs. The contingency plan shall address the following:

- Responsibilities
- Monitoring
- Emergency response procedures
- Equipment available for containment control and clean up.
- Proposed methods for clean-up.
- Procedure for continuation of drilling.

Drilling fluids and drill spoils shall be disposed off-site to an approved location. Details of the nominated disposal site are to the submitted to the superintendent for approval.

All relevant legislation shall be adhered to.

5.6.15 Drill Pipe

In addition to the requirements of Section 5.6 the Contractor is to supply drill pipe that is in good condition, complete with ultrasonic assessments to demonstrate their condition.

The drill pipe is to be assessed against "ANSI/API SPECIFICATION 5DP Specification for Drill Pipe" and a report provided demonstrating conformance. The drill pipe and makeup torques are to be submitted to the Superintendent's Representative and operated according to the manufacturers guidelines.

Drill Pipe management system shall be in place to log operating hours and periodic visual inspections.

The Contractor is to measure the allowable 3 and 10 joint radii for the drill pipe in real time and record it on the daily steering report (as requested in Table 8 – Technical HDD Information Records). The Contractor is to ensure that the drill pipe conforms to its allowable bending radius at all times.

Additional Sub-Clause

5.6.20 Annular Pressure Monitoring

The Contractor's design must include a theoretical calculation of hydrofracture for each crossing. This calculation is to be graphed against chainage and vertical elevation. The graph is to include plotted lines representing the following parameters:

- The topographic surface
- The vertical bore hole alignment
- The minimum pressure required to create fluid returns in the entry pit (P_{min})
- The maximum allowable pressure ground could withstand without hydrofracturing (P_{max})
- The Contractor's design must prove that P_{min} will remain lower than P_{max} including a factor of safety allowance of 1.5.

During the drilling of the pilot hole the Contractor must plot the actual annular pressure on to the theoretical graph mentioned above in real time. The Contractor is to act accordingly if P_{min} approaches P_{max}. Measures such as cleaning the hole, reducing the fluid pressure, reducing the rate of penetration (ROP) should be implemented.

Evidence of calibration of the pressure sub tool shall be submitted to the Superintendents Representative prior to commencement of the pilot bore or before re-entering the pilot bore if removed.

5.7 Survey

Replace the first paragraph in sub-clause 5.7.1 with the following:

Three readings per rod are required during the drilling of the pilot hole, registering inclination, azimuth, length and the orientation of the bent sub. This collected information is to be converted and plotted into a real time As-Built alignment drawing referencing the actual position of the borehole compared with the designed alignment. This plot is to be submitted to the Superintendent's Representative daily for review as requested in **Table 8 – Technical HDD Information Records**.